## MAN AS A MUTANT.

The failure of theology to give a comprehensive meaning to human existence was the cause of speculative philosophy. System after system, from Thales down to Bacon, attempted to explain the phenomena of nature and their relation to humanity. With the advent of the scientific era, philosophy was compelled to limit its speculations so as not to contradict the results of science and philosophy. Empiricism in philosophy became of great importance, and science became philosophic. Spencer defined philosophy as the generalization of the sciences. Science, in its turn compelled humanity to change the ideas of creation by proving that matter cannot be created or destroyed, and substituted evolution for special creation. These new ideas, coupled with the overthrow of the geocentric theory of the universe, revolutionized the whole of human thought, as shown by modern philosophy, art and literature.

Most of the philosophical systems, especially the idealistic ones, are optimistic in their nature. They all hold that nature, or its god, is conducting the universe with a special purpose in view, and that man, as the most important part of nature, has a special destiny to perform which is for his good. There are a few exceptions. Kant, although an idealist, does not show much optimism. He, like Spencer, sees constant change in nature, but unlike Spencer, he is not so sure that the change means progress. Schopenhauer developed a doctrine which may be described as a transitional form from the idealism of Kant to the prevalent realism of the present. His pessimism is derived from human experience. He emphasized with unusual lucidity the feebleness of the spontaneity of the intellect. He comes to the conclusion that not only is our world not the best, but it is the worst of all possible worlds.

The generalizations of science have a distinct bearing on the questions raised by theology and philosophy. Science in its prevaling form teaches that there can be no such thing as design in nature. Man, together with all organic life, must adapt himself to environment in order to continue his existence; and the end of all man's strivings on earth is doomed to failure. In a word, the message that science brings is woefully pessimistic. It tells us: Try as you may, make new discoveries, new inventions, dig as deep as you can in the

secrets of nature, you are one and all predestined to destruction. The following are some of the facts adduced by science in support of this gloomy foreboding.

It is well known that organic life is made possible by the energy radiated on this globe by the sun. There can be no life (except of the lowest forms) without solar energy. Science tells us that the sun's energy is diminishing continuously. Ergo, the time must arrive when the whole of the sun's energy must be exhausted. Long before that time arrives human beings will have ceased to exist. The range of temperature in which protoplasm is able to exist is very limited. The range of temperature favorable for the existence of higher forms of life is still more limited. No human being could possibly hold his own at a temperature of 60' centigrade below zero, while the absolute temperature to which the sun's energy can descend is 273' below zero. This shows that animal life on this planet must cease long before the sun is entirely extinct. The simplest experiment to show that the sun's energy is constantly diminishing is shown by an instrument known as the pyrheliometer. It is a small, hollow cylinder, presenting at one end a disk of known dimensions covered with lampblack. The body of the instrument is made of silver, well polished to prevent radiation of heat, which it absorbs through the blackened disk. The disk is turned directly to the sun. The cylinder is filled with water. All the radiant heat and light, everything in the form of radiation that falls upon the lampblack, is absorbed by it and is degraded to the form of heat energy and so communicated to the water, which contains the bulb of a thermometer, whose stem runs through the axis of the apparatus. By a simple contrivance the apparatus can be so adjusted that the blackened disk, which is always capped when not in use, will receive the sun's rays perpendicularly. The cap is removed for a measured period of time and then put on again. The instrument is shaken so that the temperature of the water remains the same throughout. The rise in temperature is shown on the thermometer. Correction is made for the loss of heat during the performance of the experiment. In this way a fairly approximate estimate of the amount of heat received from the sun in a given time can be made. By comparing the surface of the disk with the surface of the whole earth which is exposed to the sun, we can estimate how much radiant energy in the form of heat, light, actinism, and so forth, comes to us from the sun per second of time; and we can also estimate the amount of energy that leaves the whole

sun's surface every second. By many years' observation it has been conclusively shown that the average amount of energy reaching the earth is diminishing gradually. It is true that the loss is very small, on the highest estimate not more than 1' centigrade in seven thousand years, but the loss is positive; which forces the conclusion that it is only a matter of time when the earth will no longer be fit as an abode for man.

This, however, is not all. As if to make the escape doubly impossible, there is another, more general phenomenon pointing to the inevitable loss not only of life, but of all activity on earth. Our planet, in conjunction with the whole solar system, is bound to become a dead body, uniform in temperature and devoid of all motion. A thorough discussion of this idea would lead us to the subjects of Entropy and The Theory of the Potential, subjects out of place in an article of this nature, on account of the mathematical treatment that they involve. I shall, therefore, have to limit myself to a mere indication of the nature of the argument. It is based on one of the most fundamental laws of physics known as the law of the conservation of energy. The law states that energy may change its form, as mechanical into heat energy, but no energy can be a constant quantity. Experience teaches us that every change of energy from one form into another is accompanied by a loss of "available" energy. No energy was lost to be sure, but some energy has been degraded, i. e., it came down from a higher to a lower potential or level. In illustration of this principle it would be very desirable to bring in Carnot's Cycle and the subject of reversibility, were it not for the fact that it would divert us too far from the main issue. It will suffice to state that after every physical operation in the universe the whole amount of energy involved cannot be recovered in an available form. A considerable amount is lost in friction, radiation, etc. It is well known that even the most efficient steam engine converts less than one-fourth of the heat which the coal generates into useful work. The remaining three-fourths are lost, not to the universe but to man, and are thereby rendered "unavailable." As there is no process in nature which is not accompanied by a loss of "available" energy, the conclusion is forced upon us that a time must arrive when all the higher forms of energy, i. e., energy of motion, energy due to position, chemical energy, etc., will be degraded into one form of energy—radiant energy. The amount of energy will still remain constant; there will be no loss of energy, but it will all

become unavailable. Energy will reach its lowest level; after which no activity of any kind will be possible. This conclusion is a direct deduction from the second law of thermodynamics. The law is stated by Clark-Maxwell as follows: "It is impossible to transform any part of heat of a body into mechanical work except by allowing heat to pass from that body to another of a lower temperature." But as there will be no body of lower temperature in the universe it follows that all activity must cease. It is true that Clark Maxwell, the greatest mathematical physicist since Newton and Laplace, to whom all the great development in electricity, including wireless telegraphy, are due, thought that he had found a way out of the difficulty. He conceived a being whose faculties are so sharpened that he can follow every molecule in its course. Such a being, known in physics as Maxwell's Demon, could sort the molecules so as to allow the swifter ones to go into one compartment and the slower ones into another. He could then, without expenditure of work, raise the temperature of one part of the universe and lower that of the other, thus starting a difference in potential and causing new activity. I mention it here simply as an ingenious curiosity.

There is no denial of the fact that all of this is exceedingly pessimistic, and yet, as such, it must be accepted. But in all this darkness there is a gleam of light which makes it worth while for humanity not only to continue its existence but to consider its being on earth as a rare and special privilege. It is quite probable that in the whole universe man is the only being who has the privilege of a conscious existence, who is possessed of the power to analyze and synthesize objectively. It is quite probable, nay almost certain, that his conscious existence came accidentally, and that as a conscious being he is the only creature able to understand nature and study her so as to foretell phenomena centuries in advance of their appearance. All students of nature are aware of the fact that the universe is composed principally of inorganic matter. Organic life occupies an insignificant part of the time of a planet's existence. It takes untold centuries before a planet, even when favorably placed in the solar system, is able to support life. After a brief period comparatively speaking, it becomes lifeless like the moon and remains so indefinitely. A glance at our solar system will show that of all the planets that are engaged in their endless cycling around the sun only one—Mars—besides the earth may be said to be favorably placed for life formation; and if Mars possesses life, the inhabitants of Mars must

be inured to somewhat severer conditions than generally prevail on earth. The other planets are either too near the sun, where the temperature is too high, or too far, where it is too cold and dark, or they are in a gasious state so as to preclude the existence of life, especially in any high form. In this connection I will cite a paragraph of J. F. W. Herschel, one of the greatest astronomers that ever lived. Speaking about the probability of animal life on the other planets, Herschel analyzed the following three features: "First, the difference in the respective supplies of light and heat that the planets receive from the sun. Secondly, the difference in the intensity of the gravitating forces which must subsist at their surfaces, or the different ratios which on the several globes, the inertia of bodies must bear to their weights. And thirdly, the difference in the nature of the materials of which, from what we know of the mean density, we have every reason to believe they consist. The intensity of solar radiation is nearly seven times greater on Mercury than on earth and on Uranius 330 times less; the proportion between the two extremes being that of upwards of 2000 to 1. Let any one figure to himself the condition of our globe were the sun to be septupled, to say nothing of the greater ratio! or were diminished to a seventh or to a 300th of its actual power! Again, the intensity of gravity, or its efficacy in counteracting muscular power and repressing animal activity, on Jupiter, is nearly two and a half times that on earth; on Mars not more than one-half, on the moon one-sixth, and on the smaller planets not more than one-twentieth; giving a scale of which the extremes are in proportion of sixty to one. Lastly the density of Saturn hardly exceeds one-eighth of the mean density of the earth, so it must consist of material not much heavier than cork. These physical peculiarities show how improbable it is for higher forms of life to exist on the other planets of our solar system. It may, however, be argued that there are many more systems scattered through infinite space where the planets are as favorably placed to their illuminaries as the earth is to our sun. Granting the universal law of evolution, we must admit that those planets must also reach a state when their physical conditions are favorable for the support of life. Hence they too must go through the same cycle of evolution as our earth, reaching as high a state of mental development and even higher. In fact this is now the accepted belief of most scientists Proctor, reasoning on these premises, comes to the conclusion that in any given time it is safe to assume that no other life exists on

other planets than the earth. He bases his conclusion on the fact of the insignificant duration of life on any planet as compared to its lifeless existence. Given any planet, the probabilities are that either it has not as yet reached the state of development capable to sustain life—as Jupiter or Saturn—or the life sustaining period is all over, as in the moon. This is sound reasoning. It is based on the law of the Uniformity of Nature and on the Theory of Probability. This tacitly assumes the existence of life, in all its forms, on every planet during a certain period of its development.

Reasoning, however, from different data, that came to light since Proctor's essay was written, it seems to me that there are strong grounds that preclude such an assumption. According to Darwin, the animal kingdom has developed very slowly from the lowest organism into the highest forms of life. The time required for such development was recognized by Darwin himself to be very enormous. This great length of time would not matter in an ocean of infinity, had there been no objection from other quarters. Both astronomy and geology in calculating from their respective data the probable age of the earth, fall short of the time necessary for the development of the different species on a planet ripe to support life. It is also interesting to note that, although starting from different considerations, the conclusions reached by both astronomy and geology as to the probable age of the earth is almost the same. There is good reason to believe that Darwin forsaw this difficutly but could not account for it. Lately, however, new light was thrown on this subject by the investigations of Hugo De Vries. In his "Experiments and Observations on the Origin of Species," De Vries propounds what is known as the mutation theory. According to this theory life has not developed gradually and slowly but it came in leaps and bounds. Occasionally some new species appears, sometimes not at all resembling the parents and very often of a much finer and higher type. This new species continues to propagate its own type without ever returning to the lower characteristics of the ancestors. By accepting this theory (and it is now universally accepted by biologists) the time for the development of life on earth is very much reduced, so as to fit in with the calculations of the astronomers and geologists. That man is a descendant of the simian family is accepted by almost all biologists. New evidence has lately been added from quite different sources which show conclusively the relationship of the human species to the anthropoid apes. From

a morphological standpoint it is admitted that there is a missing link between the highest ape and man. If this is true from the morphological standpoint, it seems to me that from a psychological viewpoint not one but a thousand links are missing between the higher animals and man. I am perfectly aware that animals possess some intelligence, and even foresight, but they do not possess to any considerable degree the objectivity, the contemplation, the conscious thought, in a word, personality, that are peculiar to the human. Not only do they not possess these qualities, but there is no evidence of their ever being able to acquire them. Huxley made the statement that his dog was more intelligent than the Australian Bushman because the dog could count up to four while the Bushman could not count more than two. If a group of more than two be presented to him he calls it "many," no matter how many units it contains. But we must take into consideration the potentialities of the Bushman. As far as I know nobody has ever succeeded in teaching a dog reading or writing, nor an anthropoid ape arithmetic or algebra. Most people would agree that such a task would prove impossible. On the other hand, there are good reasons to believe that the Bushman, through many generations of training and education, could be brought up to a high degree of culture. Circumstances have kept him in a savage state; but apparently he possesses the potentialities of the civilized human. He possesses a remarkable faculty for graphic illustration. The Bushmen show some skill in their drawings of men, women, children and animals. They are valued as servants by the Boers for their possession of sufficient intelligence to perform their work properly.

This almost infinite gap in intelligence between higher animals and man can only be explained by the mutation theory. In analyzing the physical features of anthropoid apes and man Metchnikoff infers "that man is a case of the arrested development of some simian of ancient days, as it were, a simian monster from the zoological point of view, altho not from the esthetic. Man may be regarded as a prodigy sprung from an ape, born with a larger brain and an intelligence more highly developed than occured in his parents." His appearance on earth, then, was sudden, as an accident. As such an accident he is the sole exception to all life on the globe. He is the only self-conscious animal, planning for his future, prophesying events in nature a hundred years to come, able to analyze the composition of worlds almost an infinite distance away, trying constantly

to work out a philosophy of life and rules for his individual conduct and his relation to his fellow men. He is not only the sole self-conscious animal on earth, but the probability is that he is the only one in the whole universe. Before the mutation theory was known it was quite logical for Mr. Proctor to conclude that in the course of evolution every planet favorably situated goes through a development similar to our earth, and that a time arrives, though of comparatively brief duration, when life, like the one on earth including man, must develop. With the advent of the mutation theory this conclusion becomes invalid. An unforeseen species may spring up unexpectedly, as there is good reason to believe in the case of man.

It was Simon Newcomb who suggested that the stellar system was not infinite, but finite. He based his theory on the observation of the receding of the clusters of stars in the Milky Way. Taking our sun with its attendant planets as the center, we observe that the stars in the Galaxy recede symetrically in all directions until a region is reached where there are hardly any stars visible. As the decrease of the stars from the center to the peripheri is in a convergent series, a place must be reached where there are no stars at all (as any convergent series has zero as its limit.)

Newcomb took up the other alternative, that there might be other galaxies which are so distant, that they are invisible to our telescopes; so that instead of one stellar system there may be a great number, even an infinity of stellar systems. This idea was first suggested by Kant, who believed that the most distant nebulae constituted other Milky Ways or stellar systems as extensive as ours. Although he admits such a possibility but from the symmetry of the arrangement of the stars and other considerations, he shows that the probabilities are against such a supposition. Consequently our stellar system is the only one, and is therefore finite.[1]

Riemann's Geometry, which postulates a finite universe, may lend color to the argument. Although Riemann was a pure mathematician, there are many examples in the history of science showing that the visions of theorists have proved true prophecies of nature. or, in the words of Schiller

> "Mit den Genius steht die Natur in engen Bunde
> Was der eine verspricht, leisted die anderegewiss."

[1] "Theorethical researches of Einstein and Weyl make it probable that space which remains beyond (the visible universe) is not illimitable; not merely the material universe, but space in itself is perhaps finite." A. S. Edington, *Science*, Sept. 10, 1920.

Now, the finity of the universe being granted, the chances in a finite universe for another intelligent human, as the one on earth, to spring up by accident, where an infinite number of excluding combinations of probabilities are involved, is in the ratio of one to infinity, which equals zero.

[It may be argued that if an accident happened on earth why could not another similar accident happen on another planet? Why is it not probable that by chance in other planets high forms of life spring up, even higher than man?

If man were a natural development of evolution we would expect the same result on every planet in the course of its development. Once, however, we regard him as a creature of accident, the chances from a mathematical consideration of his coming on other planets in a finite universe, has been shown above to be equal to zero.] If man, then, happens to be the sole creature in the universe of organic life, and inorganic matter, who is capable of conscious. objective thought, there is no reason for an utter pessimism. The very fact that he is seeking for his place in nature and conscious of his surroundings is sufficient reason for his being happy. He knows that he is alive and thinking. Though the days of his life be few and troublesome, he is still the only seer who came accidentally to this privilege and is conscious of his destiny. He is the only one able to plan and work for a brighter life for those of his kind who will come after him. This thought ought to keep him happy and inspire him with courage even during misfortune and disease. It is still better to suffer and know than to become non-existent and be absorbed into the infinity of inanimate matter. In the words of Poincare: "Geologic history shows us that life is only a short episode, conscious thought has lasted and will last only a moment. Thought is only a gleam in the midst of a long night. But it is this gleam which is everything."

His objective attitude toward nature enables him to protect himself against noxious elements in his environment, and by the mastery of her laws to succeed in adapting her to his needs and pleasures, not to mention the greatest of all satisfactions that he derives from the very act of plying into nature's secrets and the admiration of her as an aesthetic phenomenon.

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